6.0 AQUATIC RESOURCES

6.1 Affected Environment

The cumulative assessment area encompasses four major drainages, which include the Boulder Creek subbasin, Maggie Creek subbasin, Rock Creek subbasin, and the Humboldt River. The following information describes aquatic resources in each of the four drainages. The types of information used to characterize aquatic resources include habitat, fisheries, and macroinvertebrates.

6.1.1 Boulder Creek Subbasin

Habitat surveys were conducted in Rodeo, Brush, and Boulder creeks in 1987 through 1993 (JBR 1994). Habitat quality was characterized as poor in the lower and middle portions of the streams, where relatively low flows, grazing, and erosion have affected the streams. Perennial sections of the streams such as the upper portion of Boulder Creek were characterized as moderate habitat quality.

Qualitative sampling in 1988 and 1990 indicated that Lahontan speckled dace (*Rhinichthys osculus robustus*) was the only fish species present in Rodeo, Brush, and Boulder creeks (JBR 1990b, 1988). This species is able to tolerate poor habitat conditions indicative of these streams.

Based on studies conducted in Rodeo and Brush creeks, and the lower and middle portions of Boulder Creek from 1987 through 1993, macroinvertebrate communities were composed of relatively few taxa that were highly tolerant of environmental stress (JBR 1994). The headwaters of Boulder Creek contained moderate numbers of macroinvertebrates and some pollution-sensitive taxa. In Brush and Rodeo creeks, a shift toward pollution-tolerant taxa occurred beginning in 1990. Possible factors causing this shift included increased sediment loads and relatively low flows (JBR 1994). Brush Creek has been dry since 1994 (ABC 1997).

6.1.2 Maggie Creek Subbasin

6.1.2.1 Habitat

Diverse habitat conditions are present in the Maggie Creek subbasin. Maggie Creek, Susie Creek, and the lower reaches of most of the Maggie Creek tributaries are characterized as low-gradient streams with wide channels (BLM 1993b). Implementation of the Maggie Creek Watershed Restoration Program and controlled grazing on lower Susie Creek have stabilized banks and improved riparian vegetation. The lower reaches in Little Jack, Coyote, and Lynn creeks often dry up during the summer months due to low flows, which limit habitat quality. In contrast, the headwaters of Little Jack and Simon creeks and the wet-meadow areas along lower Coyote and Little Jack creeks contain stable, vegetated channels, with higher flows during the summer.

Beaver Creek originates on the eastern slope of the Tuscarora Mountains from small springs and seeps. The upper portion of the stream flows through deeply incised canyons, whereas the lower portion meanders through sagebrush-covered hills. In 1994, aquatic habitat was limited in the Beaver Creek drainage by channel size and streamflow (Valdez et al. 1994). Few large, quality pools with overhanging vegetation were present. Below approximately 6,500 feet in elevation, low flows reduced available aquatic habitat. Since 1993, a combination of riparian fencing and controlled grazing has resulted in stable, well-vegetated streambanks, and formation of quality pools (Evans 1999a).

As mitigation for the South Operations Area Project, Newmont in conjunction with BLM and Elko Land and Livestock Company, implemented the Maggie Creek Watershed Restoration Project in 1993. The result of this mitigation plan is that aquatic habitat parameters such as riparian zone width, riparian condition class (percent optimum growth), stream width/depth ratio, bank overhang distance, woody vegetation overhang distance, and percent stream width with quality pools have improved significantly in the Maggie Creek Subbasin since 1993 (BLM 1997a). Specific streams with improved conditions included mainstem Maggie, Coyote, Little Jack, and Simon creeks.

6.1.2.2 Fish

Electrofishing surveys were conducted in 10 streams within the Maggie Creek subbasin in 1992 (JBR 1992c). Eight of the streams contained fish populations, with speckled dace representing the most common and widespread species. Other species present included redside shiner (*Richardsonius balteatus*), mountain sucker (*Catostomus platyrhynchus*), brook trout (*Salvelinus fontinalis*), and LCT (*Oncorhynchus clarki henshawi*). Of these species, one is important as a recreational game fish species (brook trout) and one has Federally threatened status (LCT). Brook trout was present in Spring Creek, while Jack Creek, Little Jack Creek, and upper Maggie Creek contained LCT populations. See Appendix F for additional data on fisheries surveys. The upper 5.5 miles of Coyote Creek, which is located upstream of the 1992 study area, also supports a LCT population (BLM 1994b).

In 1997, fish sampling was conducted in seven streams (Lynn, Maggie, Beaver, Little Beaver, Spring, Little Jack, and Coyote creeks) located within the Maggie Creek subbasin (AATA International 1997). Species collected in the streams included speckled dace, Lahontan redside (*Richardsonius egregius*), Tahoe sucker (*Catostomus tahoensis*), and LCT. Speckled dace was the most abundant species in the middle and lower portions of all streams. LCT were collected in the upper canyon portions of Beaver, Little Jack, and Coyote creeks, where they dominated the fish numbers. One LCT population also was found in a spring-fed reach in lower (Indian) Jack Creek. Additional information regarding the abundance, habitat preferences, and life history of LCT is provided in Chapter 7.0, Threatened, Endangered, Candidate, and Sensitive Species.

Fish communities in the Beaver Creek drainage, which flows into Maggie Creek, consist of four species: LCT, speckled dace, Lahontan redside, and Tahoe sucker (Valdez et al. 1994). Juvenile LCT were collected in seven of the nine streams; adults were captured in Beaver Creek, Little Beaver Creek, Toro Canyon, and three unnamed tributaries to Toro Canyon (see Appendix F). The lower segments of Beaver and Little Beaver creeks also were surveyed in May 1997, with Lahontan redside shiner, speckled dace, and LCT being collected in low numbers (AATA International 1998a). Two LCT were collected above the road culvert that were assumed to have been washed downstream during high spring flows. Young-of-the-year were observed in Toro Canyon.

6.1.2.3 Macroinvertebrates

Based on studies conducted in November 1991 and April 1992, streams within the Maggie Creek subbasin exhibited differences in macroinvertebrate productivity and composition (BLM 1994b; JBR 1992c). Moderately diverse and productive communities were present in portions of Little Jack, Fish, Coyote, Maggie, James, Susie, West Cottonwood, Marys, Indian, and Mack creeks. In most instances, the productive and diverse communities were limited to the headwater portions of these streams. The macroinvertebrate assemblage in these streams consisted of a mixture of both pollution-tolerant and pollution-sensitive taxa. Mayflies (*Cinygmula*, *Drunella grandis*, and *Rhithrogena*), caddisflies (*Capnura*, *Isoperla*, and *Sweltsa*), and stoneflies (*Hydroptila*, *Lepidostoma*, and *Zapada*) represented the taxa that were considered sensitive to various types of environmental stress. The middle and lower portions of these streams usually were dominated by pollution-tolerant taxa such as chironomid midges, oligochaete worms, blackfly larvae, and mayflies (*Baetis*). Other streams, including Buck Rake Jack, Cherry Spring, Indian, Jack, Lynn, Simon, and Spring creeks, also contained communities dominated by pollution-tolerant taxa.

Macroinvertebrate sampling also was conducted in 1997 at sites within Little Jack, Spring, Coyote, Toro Canyon, and Beaver creeks (AATA International 1998a, 1997). Low to moderate densities were reported in the streams, with mayflies, caddisflies, Diptera, midges, and amphipods usually representing the most abundant taxa. The upper canyon portions of the streams contained taxa that indicated generally good water quality conditions, while the lower stream portions were dominated by pollution-tolerant taxa.

6.1.3 Rock Creek Subbasin

6.1.3.1 Habitat

Aquatic habitat has been monitored in numerous streams within the Rock Creek subbasin with emphasis on those perennial segments that support LCT populations (AATA International 1998b; NDOW 1996b; BLM 1994b, 1998c). The following information summarizes habitat conditions in Rock Creek and its tributaries.

<u>Upper Rock Creek</u>

The upper 10 miles of Rock Creek exhibited fair to good habitat conditions in 1977, 1986, and 1997 (BLM 1994b, 1998c). Although bank stability and pool width have declined since 1977, bank cover, stream width-to-depth ratio, and substrate composition have continued to be characterized as fair to good ratings (BLM 1998c). The upper reach contains stable banks and a well developed riparian zone.

<u>Willow Creek</u>

Habitat conditions in Willow Creek, both upstream and downstream of Willow Creek Reservoir, were rated as poor in 1977 and 1986 (BLM 1994b). Lower Willow Creek below the reservoir was characterized by a complete absence of pools, unstable streambanks, high levels of sedimentation, and a well developed riparian zone. Limiting habitat parameters in the upper portion of Willow Creek included an absence of quality pools, unstable streambanks, and low to moderate sedimentation (NDOW 1996b). Cattle grazing has impacted the upper and lower portions of the stream. Surveys conducted in 1997 (AATA International 1998b) indicated improved habitat conditions, with low embeddedness and a decrease in the average depth/width measurements. Bank cover also has improved since the 1977 survey (BLM 1998c).

Nelson Creek

Habitat conditions in this headwater tributary to Willow Creek were rated as fair in 1977 and poor in 1986 and 1997. Limiting factors included sedimentation, few quality pools, unstable streambanks, lack of substrate diversity, and minimal bank cover (AATA International 1998b; NDOW 1996b; BLM 1994b). Cattle grazing and beaver activity have impacted the stream.

Lewis Creek

In general, this headwater tributary to Willow Creek exhibits higher quality habitat compared to most of the Rock Creek tributaries (BLM 1994b). Habitat conditions were rated as fair in 1977 and 1986. In 1996, bank stability, bank cover, and substrate diversity were rated as fair (NDOW 1996b). A lack of quality pools and low pool/riffle ratio were considered major limiting factors. Habitat conditions were improved in 1997, as indicated by an excellent pool/riffle ratio, very good substrate material, low embeddedness, and bank overhang (AATA International 1998b).

Frazer Creek

Habitat conditions in the upper canyon portion of the stream were rated as poor in 1977 and 1986, with limiting factors consisting of unstable banks, few quality pools, and lack of substrate diversity (BLM 1994b). In 1996 and 1997, the mid-canyon portion of the stream was rated as fair to excellent habitat quality (AATA International 1998b; BLM 1998c; NDOW 1996b). Stable banks, cover, diverse substrates, and a good mixture of pools and riffles contributed to the high quality habitat. The only limiting factor was a lack of quality pools. Habitat conditions were rated as fair in the lower reach, with a less developed riparian zone compared to the upper reach (BLM 1998c).

Toe Jam Creek

Of the 15-mile section with perennial flow, 13 miles were rated as poor habitat in 1977 and 1986 (BLM 1994b). Factors limiting habitat quality consisted of unstable banks, lack of streamside vegetation, dominance of fine sediment substrates, and lack of pools with depth. The upper 2-mile section of Toe Jam Creek showed an improvement in bank stability, cover, and mixture of substrates. Habitat quality in 1997 indicated improved conditions, with an overall rating of fair to good aquatic habitat (AATA International 1998b; BLM 1998c). Limiting factors still exist, as indicated by substrate embeddedness and reduced bank cover and bank stability ratings (BLM 1998c).

6.1.3.2 Fish

Based on surveys conducted in the Rock Creek subbasin during June 1996 by NDOW, perennial streams contained LCT and native species such as Lahontan speckled dace, Tahoe sucker, mountain sucker, and redside shiner (NDOW 1996b). LCT were collected in upper Rock Creek, Lewis Creek, Nelson Creek, Toe Jam Creek, and Frazer Creek. A more detailed discussion of LCT distribution in these streams is provided in Section 7.1.2. Lahontan speckled dace usually was the most abundant species in the streams. Electrofishing surveys also were conducted in three Rock Creek tributaries (Trout, Soldier, and Coyote creeks) during 1993 and 1996 (BLM 1997b; NDOW 1993b). Lahontan speckled dace was the only species present. Speckled dace, redside shiner, and Tahoe sucker were observed in Antelope Creek (McGuire 1995).

6.1.3.3 Macroinvertebrates

Based on surveys conducted in August 1997, macroinvertebrate communities in upper Rock, Toe Jam, Lewis, Nelson, and Frazer creeks exhibited relatively low densities and moderate taxa richness (AATA International 1998b). Total densities ranged from approximately 237 organisms/meter^2 (m^2) in Toe Jam Creek to 978 organisms/m^2 in upper Rock Creek. The total number of taxa ranged from 21 (Toe Jam Creek) to 33 (Frazer Creek). Mayflies and caddisflies were the most abundant groups in all streams. Other common taxa included dipterans (chironomid midges and blackfly larvae), stoneflies, and beetle larvae. The percent composition of mayflies, stoneflies, and caddisflies indicated generally good water conditions.

6.1.4 Humboldt River

6.1.4.1 Habitat

Habitat conditions were characterized in 1997 (JBR 1997) at 13 locations extending from Carlin to approximately 2 miles downstream of the Rock Creek confluence (Appendix F, Table F-4). Habitat quality varied throughout the 55-mile section of the river, depending upon the extent of cattle grazing, abundance of pools, bank stability, and streamside cover. The upper four sampling locations (Barth to Dunphy) contained a fair to high abundance of pools; poor to excellent streamside cover; low to moderate grazing; and fair to good bank stability. From Dunphy downstream to the Rock Creek confluence, the river exhibited a fair to high abundance of pools; fair to good bank stability; and mostly low streamside cover.

Historical land use practices involving willow control, livestock grazing, and channelization along the Humboldt River have contributed to the generally less than optimal habitat conditions (Rawlings and Neel 1989). Other factors that have resulted in reduced habitat quality in the river include sediment loads, irrigation diversion, irrigation return flows, and relatively high water temperatures (BLM 1996b). Monitoring studies reported that irrigation return flows have contributed to elevated levels of arsenic in fish in Rye Patch Reservoir and downstream areas (Seiler et al. 1993).

6.1.4.2 Fish

The Humboldt River is considered a warm water fishery that consists of species that can tolerate relatively high sediment loads and warm temperatures. Twenty-three species were reported in previous surveys in the river, with sunfish, catfish, and minnow families containing the most species (see Appendix F, Table F-5). Game fish species occurring in the Humboldt River include channel catfish, white catfish, black bullhead, yellow perch, white bass, largemouth bass, smallmouth bass, sunfishes, and crappies. All of these game fish species were intentionally or accidentally introduced. The only native species in the river are suckers, Lahontan redside, redside shiner, Lahontan tui chub, and Lahontan speckled dace.

Electrofishing surveys were conducted in November and December 1995 at nine sampling locations in the Humboldt River that extended approximately 2 miles upstream of Dunphy downstream to the Rock Creek confluence (JBR 1997). Relative abundance information indicated that the minnow species and Lahontan mountain sucker were the most abundant species, while game fish numbers were relatively low. These results are similar to other surveys conducted in the Humboldt River (JBR 1992c).

Game fish inhabiting Rye Patch Reservoir include walleye, channel catfish, largemouth bass, smallmouth bass, spotted bass, white crappie, and yellow perch. In 1968, walleye (a cold water species) was stocked in Rye Patch Reservoir. Although the walleye population thrived during years with high streamflows, population declines occurred during dry years (BLM 1996b). The extended drought in the 1990s caused the walleye fishery to largely disappear. Presently, most of the remaining walleye spawn downstream of Mill City (French 1994; as cited in BLM 1996b). In the 1970s and early 1980s, walleye spawned between Rye Patch Reservoir and Winnemucca in late March and April in water temperatures ranging from 50° to 53° F. Game fish species comprise a minor portion of the overall fish numbers in the Humboldt Sink area (Sevon 1998). Recreational fishing in this area is insignificant due to the low numbers of game fish and limited access. White bass and white crappie, which originate from Rye Patch Reservoir, are the most abundant game fish species in the Humboldt Sink. Other game fish species that are likely present include bullheads, channel catfish, white bass hybrids (wipers), walleye, largemouth bass, smallmouth bass, spotted bass, crappies, sunfishes, Sacramento perch, and yellow perch. Nongame species such as Tui chub, Sacramento blackfish, gambusia, and carp dominate the overall fish numbers. Aquatic habitat in the Humboldt Sink consists mainly of marshy areas with submersed and emergent vegetation.

Several monitoring programs are currently being conducted in the Humboldt River to provide information on community structure and environmental contaminants. Aquatic community structure and function are being assessed by the University of Nevada at 10 mainstem sampling sites. In addition, the USFWS and USGS are conducting a monitoring program to assess surface water quality and trace elements in aquatic vegetation, invertebrates, fish, and birds in the middle and lower portions of the Humboldt River (Wiemeyer and Tuttle 1997). Field data were collected in 1998 and 1999 for this program.

6.1.4.3 Macroinvertebrates

Thirteen locations, which extended from the Barth Mine near Carlin (upstream end) to approximately 2 miles downstream of the Rock Creek confluence (downstream end), were sampled for macroinvertebrates in the summer and fall of 1995 and 1996 (JBR 1997). Macroinvertebrate communities were low to moderately productive, with mean densities ranging from less than 100 to approximately 10,600 organisms/m^2. The highest densities occurred during the fall sampling period. The upper portion of the river from Barth to the Lander County levees contained a higher number of taxa (9 to 18), compared to 3 to 9 taxa in the lower section from Argenta Siding to below the Rock Creek confluence. In general, macroinvertebrate communities in the sampled portion of the Humboldt River were dominated by mostly tolerant taxa that have adapted to fluctuating flows and sedimentation. The most abundant taxa included chironomid midges, mayflies (*Tricorythodes minutus* and *Baetis*), and caddisflies (*Cheumatopysche* and *Hydropsyche*). The mayflies, *Cinygmula* and *Rhithrogena*, also were abundant during one or more sampling periods from Shoshone to the Lander County levees. These two taxa are sensitive to poor habitat conditions. Other sensitive taxa such as stoneflies (*Isoperla*, *Isogenoides*, and *Taenionema uinta*), caddisflies (*Culoptila* and *Glossosoma*), and dipterans (*Hexatoma*, *Erioptera*, and *Dicranota*) were present in relatively low numbers in the section between Carlin and the Lander County levees. These taxa were usually absent in the lower section of the river from Argenta Siding to below the Rock Creek confluence. Analyses of the Community Tolerance Quotient (CTQ), which rates the invertebrate's tolerance to environmental conditions, provided additional information regarding habitat conditions in the Humboldt River. The average CTQ values indicated fair habitat conditions in the section from between Carlin and the Lander County levees, and poor habitat conditions from Argenta Siding to below the Rock Creek confluence (JBR 1997).

Macroinvertebrate studies also were conducted between Battle Mountain and Winnemucca in 1995, 1996, and 1998 (Queen of the River Fish Company 1998). In 1998, the sampling stations ranged between Mote and the Eden Valley Bridge in Humboldt County. In general, taxonomic composition and densities were similar to upstream stations sampled by JBR (1997). In 1998, mean densities ranged from 886 organisms/m^2 near Mota to 10,488 organisms/m^2 near the Stonehouse Bridge. The most abundant taxa included chironomid midges, *Tricorythodes minutus* (mayflies), and *Hydropsyche* (caddisflies). The total number of taxa ranged from 9 to 15. Biotic indices such as the CTQ and Biotic Condition Index indicated fair habitat conditions at Mota and the Stonehouse Bridge, and poor conditions at the Comus gage and Eden Valley Bridge. However, the 1998 data indicated improved conditions at the two downstream stations in comparison to 1995 and 1996 results.

6.2 Impacts from Mine Dewatering and Localized Water Management Activities

Cumulative impacts predicted for aquatic resources are based on the results of the cumulative hydrologic modeling analyses described in Section 3.2.4. These analyses predicted the maximum extent of the 10-foot ground water drawdown contour (Figure 3-14). The drawdown contour represents effects in the ground water system. Impacts on surface water flows from ground water drawdown depend on the interconnection between ground water and surface water systems. Therefore, an analysis was conducted to determine the areas where perennial surface waters (both stream segments and springs) could potentially be impacted by the ground water drawdown. These areas are represented by the shaded areas in Figure 3-15.

The analysis predicted that both current and future drawdown could affect some springs and perennial reaches within the Maggie Creek, Susie Creek, Marys Creek, Boulder Creek, and Rock Creek subbasins, as illustrated by the shaded areas in Figure 3-15. Perennial streams within these potentially affected areas include: 1) Maggie Creek subbasin (Maggie, Simon, Lynn, Little Jack, Jack, and Coyote, Beaver creeks); 2) Susie Creek; 3) Marys Creek; 4) Boulder Creek subbasin (Rodeo, Brush, and Bell creeks); and, 5) Rock Creek subbasin (North Antelope, Antelope, and Squaw creeks).

The effect of decreased perennial streamflows would be a reduction of aquatic habitat that supports LCT and other native fish species, periphyton, and macroinvertebrate communities. This reduction of habitat (either in quality or areal extent) could result in decreased numbers in these aquatic communities. The magnitude and duration of effect would depend upon the amount of flow reduction. If stream segments become dry as a result of reduced flows, aquatic habitat and associated biota could be eliminated. Current dewatering activities have impacted several springs and perennial and intermittent reaches in Brush and Rodeo creeks, which do not support LCT. The models predict that drawdown could continue to expand and reach a maximum at approximately 100 years postmining. Afterward, there would be a gradual (but partial) recovery of the aquifer and associated surface waters.

Any surface water impacts on the eastern side of the Tuscarora Mountains would likely occur in water bodies located at lower elevations; these lower elevation waters are likely connected to the regional aquifer and could be affected by the dewatering activities. The higher elevation waters are thought to be isolated from the deep aquifer that is being affected. As a result, these higher elevational waters (and their associated aquatic communities) are not predicted to be impacted by the dewatering activities.

6.3 Impacts to the Humboldt River and Its Tributaries Used for Discharge Conveyance

The effects of flow changes in the Humboldt River on aquatic communities and their habitat were analyzed in qualitative terms for the cumulative project operations and postmining conditions. The study area extended from the Battle Mountain gage downstream to the Humboldt Sink. The impact discussion addresses both the projected mine discharge period (through 2011) and post-discharge conditions (after 2011). Impact topics discussed for the discharge period include flow changes and water quality (sedimentation, temperature, and metals).

As described in Section 3.3, cumulative mine water discharges would result in flow increases in the Humboldt River during mining operations. The largest relative flow increases would occur during the low-flow periods in late summer and fall. Relatively small flow increases would occur in the peak flow months of April, May, and June. The effects of these flow increases on fish communities would be an increase in wetted habitat, which would be most pronounced in the summer and fall months of average and low-flow years. The increased wetted area could be beneficial for introduced game fish species that prefer higher river volumes. Since native fish species have adapted to extreme fluctuations in flow, it is expected that these species also would be able adapt to increased river volumes. However, the possible reduction of shallow pools and braided channels in the late summer and fall months due to increased discharges could adversely affect the development of young fish, particularly native minnow species. Increased flows also could result in fish composition changes, as introduced species would be able to disperse and utilize wider areas of the river and likely compete with native species.

The effects of increased flows on macroinvertebrate communities would be beneficial, since additional wetted area would be available for development. Productivity could increase in the summer and fall months compared to premine discharges, as macroinvertebrates utilize previously dry portions of the river. Insect orders that prefer permanent flow conditions (e.g., mayflies, stoneflies, caddisflies, and chironomid midges) could exhibit increased numbers. In contrast, taxa that previously inhabited shallow pools and braided channels may show decreased numbers.

The effects of cumulative discharges on aquatic communities in Rye Patch Reservoir and the Humboldt Sink could be beneficial. Water levels in Rye Patch Reservoir could increase, which would provide additional wetted area for both fish and macroinvertebrate communities. Game fish species such as walleye, channel catfish, largemouth bass, smallmouth bass, spotted bass, white crappie, and yellow perch would be able to utilize additional areas in the reservoir for feeding and important life history events. Increased wetted areas also could occur in the Humboldt Sink area during high water years. The presence of additional habitat during high flow years could result in increased numbers of nongame fish species and macroinvertebrates. Numbers could decline again in average and dry years, when only minor increases in wetted area would be expected. Higher water levels in Rye Patch Reservoir in the summer and fall months may result in some game fish species being washed downstream into the Humboldt Sink area. Species that can utilize vegetated areas with minimal flow for spawning (i.e., sunfishes) also may exhibit increased numbers.

Overall, the effects of mine discharges on sediment levels in the majority of the Humboldt River would be considered minor. However, cumulative mine discharges may result in erosion and sedimentation impacts near the Comus gage (5-mile segment) and the Barrick outfall (10-mile segment), as the low-flow channels adjust to higher seasonal discharges. It is possible that increased sediment levels, as expressed as suspended solids and turbidity, may exceed water quality standards for protecting aquatic life (i.e., warm water fishery) in portions of a 15-mile section of the Humboldt River. Although fish species that inhabit the Humboldt River have adapted to moderately high sediment levels, high concentrations for a long period of time could affect fish physiological processes (Waters 1995). Some fish may avoid the area with increased sediment levels. Increased sediment levels in these portions of the river could result in reduced macroinvertebrate numbers and changes in composition. During periods of increased sediment loads, the macroinvertebrate community could shift to taxa that are able to tolerate these conditions. After sediment levels return to lower concentrations during postmining, macroinvertebrate composition would shift to taxa that currently inhabit the river.

Discharges from the cumulative projects could collectively cause a slight change in river temperatures ($<2^{\circ}C$) compared to premine discharges. Each project would be required to meet the State of Nevada standard for protecting warm water biota (change of $\leq 2^{\circ}C$). Therefore, river temperatures after the discharges are combined are expected to exhibit only a minor change in temperature. During average and high-flow years, river depths and widths would increase only slightly due to mine discharges. As a result, no measurable change would be expected during these years. During low-flow years, average depths would increase from approximately 0.5 to 1.5 feet. Increased depths and a more consistent flow pattern would likely contribute to slight reductions in river temperature during the low-flow period. Although it is not possible to quantify the magnitude of the temperature change, it is expected that slightly cooler water would not affect aquatic biota. In general, aquatic species that inhabit the Humboldt River are able to withstand relatively large fluctuations in temperature.

The effect of increased discharges in the Humboldt River on water quality conditions is discussed in Section 3.3. Using predicted concentrations for arsenic, copper, and zinc at Rye Patch Reservoir, comparisons were made to the Nevada aquatic life standards. These comparisons indicated that the concentrations should be below the aquatic life standards for these parameters. Therefore, cumulative project discharges are not expected to affect aquatic species in terms of dissolved metal concentrations in the water column for these parameters. However, analysis indicated that dissolved arsenic, boron, and fluoride loads could increase in the Humboldt Sink (see Section 3.3.8.3). It is possible that metals could increase in sediments, but data are not available to quantify the potential changes. No impact evaluations of metal concentrations were completed for the Humboldt Sink, since game fish species do not occur in this area on a consistent basis.

Postmining effects of dewatering on baseflows in the Humboldt River could occur in the fall and winter. Substantial reductions could occur during the summer months in average flow years. Both fish and macroinvertebrate species that inhabit the Humboldt River have adapted to extreme fluctuations in flow. It is expected that aquatic communities would not be dramatically affected in terms of numbers or composition as a result of the larger flow reductions during one or two summer months.